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Porous piezoelectric ceramics with 3-3-connectivity fabricated by impregnation of cellulose paper structures

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Abstract

Porous piezoelectric ceramics with an interconnecting pore network (3-3 piezoceramic-air-composites) are a compromising material for sensor applications. Using a biomorphous approach with pre-pyrolised cellulose fiber paper as template for the impregnation process leads to a novel porous piezoelectric ceramic with a fiber microstructure and benefits on easy shaping of complex structures and high porosity (~ 90 vol. %). The templates were impregnated by a non-aqueous lead zirconate titanate (PZT) slurry (solid fracture of 52.3 %). After residual slurry and binder removal and cellulose/carbon burn-out, sintering was carried out at 1150 °C. Microstructure and composition analyses were done by μ CT (“Skyscan 1172”, Bruker), SEM (FESEM, Helios NanoLab 600i FIB Workstation, FEI) and X-ray diffraction measurements (Kristalloflex D500, Siemens AG) evaluation. Geometric density decreased by 30% compared to dense PZT (as reference) a porosity increased from 2.4% up to 86%. The piezoelectric properties as d_{33} , relative permittivity and d_{31} (measured by “Piezo-Meter PM 300”, Piezo Test) decreased up to 99%.

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